USE OF ANTIBIOTICS IN THE PRESERVATION OF PRAWN

P. K. SURENDRAN AND K. MAHADEVA IYER
Central Institute of Fisheries Technology, Ernakulam, Cochin-11

Effect of incorporating chlorotetracycline (CTC) in ice upto 5 ppm level on the keeping quality of prawns has been studied. A shelf life extension by nearly six days is obtained for the CTC-iced sample over the control. The headless prawns absorbed greater amounts of CTC than whole prawns during storage in CTC-ice. Traces of the antibiotic are found in the muscle of the CTC-iced prawns even after cooking for one hour. The cause of destruction of CTC when used for prawn preservation is discussed.

INTRODUCTION

Much work has been done all over the world on the use of antibiotics, especially of the tetracycline group for the preservation of perishable foods. A great variety of species of both fresh water and marine fish have now been tested using ices containing either chlorotetracycline (CTC) or oxytetracycline (OTC) or dipping them in very dilute solutions of these antibiotics. (Boyd *et, al*, 1953, 1957 a;Shewan, 1956 a, b; Velankar and Kamasastri, 1957; Lerke and Farber,1957,1960 a; Castell and Greenough, 1958 a, b and c; Shewan and Stewart, 1958; Visweswariah *et al*, 1959; deSilva, 1960; Tarr, 1961; Chari, 1961; Dubrova, 1961. deSilva and Hughs, 1962; Tomiyama, 1962; Yone, 1962; Noguchi, 1962; Joseph and Srinivasan 1967). Information available on treatment of shell fish with antibiotics is limited when compared to that available for other varieties of fish. With shell fish, experiments had been confined mainly to shucked oysters (Boyd and Tarr, 1956; Abbey *et al*, 1957; Novak, *et al*, 1958), cooked lobster meat and shucked clams (Wrenshall, 1957) and raw shrimp or crab (Higman *et al* 1954; Farber, 1954; Farber and Lerke, 1956; Camber *et* al 1956; Lerke and Farber, 1957). In most of these studies, the shell fish was dipped in CTC solutions containing 5 to 20 ppm CTC and subsequently stored in ordinary ice. Camber et *al* (1955, 1956) used ice containing 10 μg / g CTC for the preservation of raw pink shrimp. The present study was undertaken with a view to understanding the various aspects of the use of CTC – ice for the preservation of Indian prawns.

METERIALS AND METHODS

In all experiments the prawns were washed with sea water and packed immediately in thermocole insulated ice boxes

with the antibiotic ice (5 ppm CTC – ice); the control sample being kept in ordinary ice. The prawns were of medium size (10-15 cm) and comprised of *Metapenaeus affinis* and *Metapenaeus dobsoni*. Initial sampling was done immediately after reaching the laboratory (4 – 6 hours after catch) and subsequent ones at intervals during 22 days of storage, when ice losses were made up by addition of the respective ices, usually on alternate days.

Samples were taken under aseptic conditions, peeled and deveined and about 10g of the muscle were used for the determination of total viable plate count by standard methods. Sterile aged sea water was used for dilution of the sample and sea water agar (SWA) containing 1% peptone, traces of $FePO_4$, 1.5% agar and aged sea water; pH=7.1, sterilized at 1.05 kg for 30 mts, for plating. The plates were incubated at room temperature (28°C) for 48 hours and counts taken.

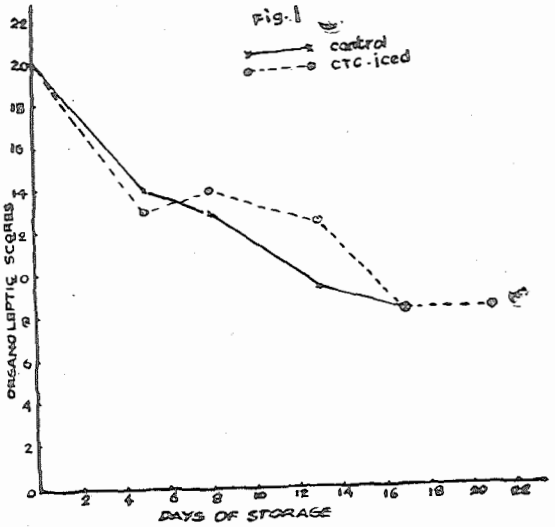
Trimethylamine nitrogen (TMAN) was determined by the Conway microdiffusion method (Conway and Byrene 1933) and volatile acid number (VAN) by the method described in A. O. A. C. (1960). CTC absorbed by the muscle during storage in CTC – ice was determined by the microbiological assay procedure of Tomiyama et *al* (1960 a, b).

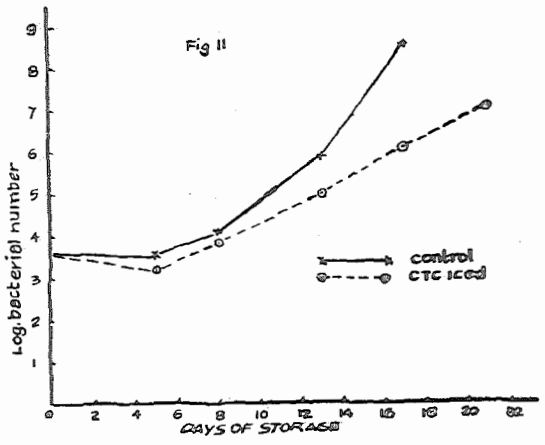
Prawn samples were examined organoleptically in both the raw and cooked states by a taste panel. The muscle was cooked in 2% NaCl solution for 10 mts and colour, odour, flavour and texture of the cooked sample noted. The scalar system of scoring was adopted. The maximum score assigned to each of the above quality factor was five, when good. The scoring rate was: Good=5; Good – fair= 4; Fair (or slightly tough in the case of texture) = 3; Fair to Poor (or moderately tough) = 2; Poor (or tough) = 1; Off = O.

For preparation of CTC – ice, "Acronize" (American Cyanamid Co.) was used, the appropriate amount of which was dissolved in tap water and frozen in aluminium trays of seven litre capacity. Water used for ice preparation was always acidic, pH= 6.4 – 6.5. CTC concentration of each lot of antibiotic ice was determined so as to ensure that the appropriate CTC activity was present in the ice used.

Results And Discussion

In all the five series of storage studies done, comparable results were obtained. Results from a typical series are shown in figs I – IV. The affect of CTC on the keeping quality of prawns was pronounced only after eight days of storage. It will be noted (fig I) that orga-



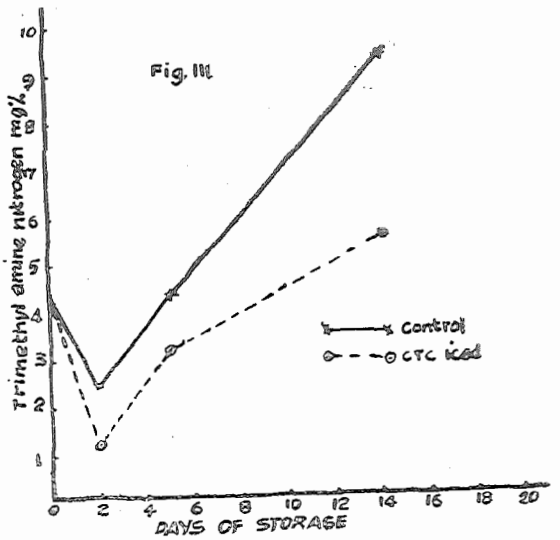


noleptically little difference could be detected between prawns kept in ordinary ice and those in the CTC – ice until 8 days of storage. In the case of the control sample, spoilage became apparent after 11 days of storage, whereas the treated sample indicated symptoms of spoilage only after 21 days as judged by smell and appearance. On the basis of organoleptic scores of the cooked muscle, the CTC – iced sample after 13 days of storage was as good as that of 8 days stored control sample. The latter became completely unacceptable on or before 11 days of ice storage, whereas the former was in good state of acceptance even on the 17th day of storage. This would mean a shelf life extension of at least six days over the control.

The bacterial counts of prawns in ice storage generally fall during the first few days and then increase. But such increase was slower in the treated sample than in control (fig II). Yet, until 8 days of storage the bacterial count did not differ much. During later period of storage, the counts of the control sample showed marked increase while that of the CTC – iced sample increased only slowly. However, for the same sensory stage of quality, the counts of the CTC – iced samples almost equalled those of the controls.

The chemical indices (TMAN and VAN) also supported the general trend noted in organoleptic and bacteriological assessment of quality. The TMAN values of the control samples were always above those of the treated samples (fig III). Though not much difference was noticed until 8 days, the VAN values of the control samples were greater than those of the CTC – iced samples during later stages of storage (fig IV).

The CTC – uptake of the muscle of of CTC – iced sample gradually increased with storage time (Table I). In the case of



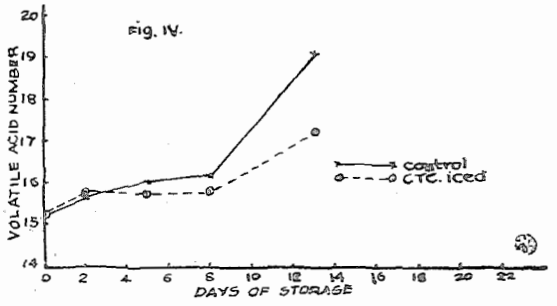


TABLE I CTC UPTAKE/GM MUSCLE DURING STORAGE IN CTC – ICE

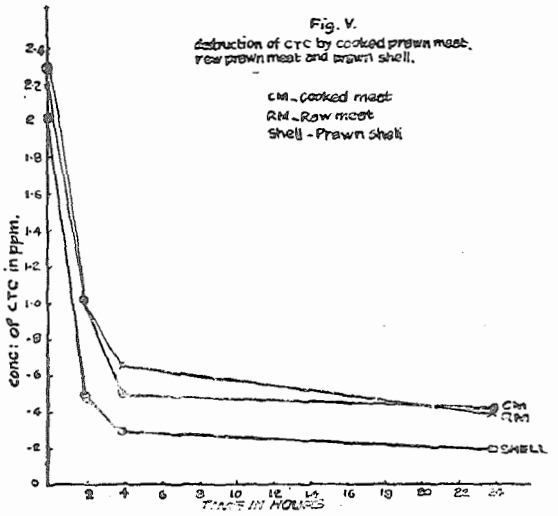
Days	CTC μg/g muscle	
	Whole prawns	Headless prawns
0	0.0000	0.00
3	0.5115	—
5	—	0.75
6	1.1195	—
8	—	1.45
11	2.1330	—
13	—	3.00
17	2.8770	6.01
19	3.2285	—
21	4.0640	7.80

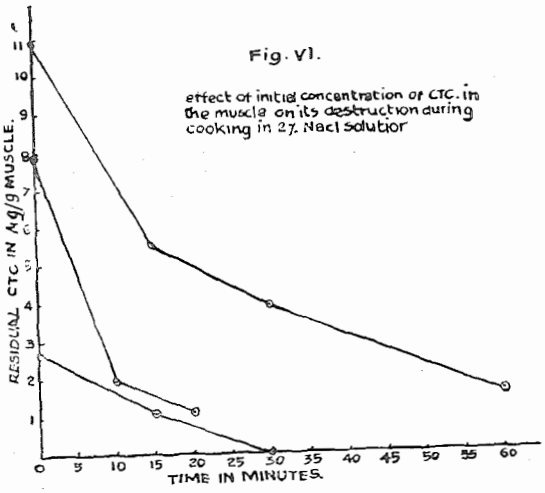
the whole prawns, a CTC level of 4.064 μg/g muscle was obtained after 21 days of storage, while 7.80 μg/g CTC was absorbed by the muscle of the headless prawns by the same period of storage.

These results clearly indicate that CTC when incorporated in ice at 5 ppm level can considerably extend the keeping quality of prawns, by not less than six days. This is somewhat different from the findings of Camber *et al* (1955; 1956) on pink shrimp, who reported only an improvement of 4 days at CTC levels of 10 ppm. This difference may be due to the destruction of CTC by other causes (Tarr, 1961) and possibly due to differences in the bacterial flora in the shrimp samples.

In the case of most species of fishes, especially cod, haddock and plaice, with 5 ppm CTC – ice a shelf life extension of 8 to 10 days over the control was recorded (Shewan, 1962). The alkaline nature of the shrimp and the presence of calcium and magnesium ions in its meat (Southcott and Tarr, 1961) would contribute to the comparative instability and consequent poor activity of the ice. This was one reason why CTC was found less effective for preservation of prawns. Fig V shows the rate of destruction of CTC at room temperature by raw prawn meat, cooked prawn meat and prawn shells. CTC is rapidly destroyed by these, the shell effecting the maximum destruction.

The higher rate of absorption of CTC by headless prawns may presumably be due to the fact that the muscle comes in direct contact with the CTC – ice. The CTC absorbed by the muscle is not completely destroyed during cooking of the muscle in 2% sodium chloride solution. Actually the extent of destruction of CTC during cooking is found to be directly related to both the initial concentration of CTC in the muscle and the cooking time (fig VI). When CTC concentration is less than 3 ppm, there is complete destruction within 30 mts of cooking.





Conclusion

From these studies it is evident that, CTC when incorporated in ice at 5 ppm level can extend the shelf life of prawns by at least six days. The use of higher levels of CTC in ice is not advisable, since it would result in higher amounts of absorbed CTC in muscle, which is not completely destroyed during cooking. It is found that CTC – ice imparts a dull colour to the shell of the prawns, which may have an adverse effect on their commercial value (although the meats of the prawns are not affected). Since the effect of the antibiotic treatment becomes pronounced only after 8 days of storage, the use of CTC – ice would be restricted to those fishing trips, where the vessel remains off-shore for more than 8 days.

ACKNOWLEDGEMENT

The authors are very much obliged to Dr. V. K. Pillai, Director, Central Institute of Fisheries Technology, for his valuable suggestions and keen interest in this work. They are thankful to the members of the taste panel for their assistance in organoleptic assessment of quality. They also acknowledge the technical assistance rendered by Shri T. John of this Laboratory.

REFERENCES:

Abbey, A, Kohler, A. R, and Upham, S. D., 1957; *Food Technol.*, 11, 265-271

A. O. A. C., 1960, *Methods of Analysis* (Association of Official Agricultural Chemists) 9th Edition.

Boyd, J. W, Brumwell, C and Tarr, H. L. A., 1953, *Fish. Res. Bd. Can. Progr. Reports Pacific Coast Station*, No, 96 *25-28.*

Boyd, J. W., Bluhm, H. M. Muirhead, C.R. and Tarr, H. L. A; 1957 a, *Am. J. Public Health.*, 46, 1531-1539.

Boyd, J. W. and Tarr, H. L.A., 1956, *Fish. Res. Bd. Can. Progr. Repts. Pacific Coast Station,* No 105, 12-13.

Castell, C. H. and Greenough, M. F., 1958 a, *Canad. Fisherm.*, 45 (10), 6.

——— and ——— 1958 b, *Ibid* 45 (11), 20.

——— and ——— 1958 c, *Ibid* 45 (12), 12.

Camber, C. I., Alexander, J. E and Vance, M. H, 1956, *Proc. Gulf. Caribbean. Fish. Inst. Univer. Miami Marine Lab.* 9th Sess. p. 32.

Camber, C. I. (with Idyll, C. P; Lopz, B, Scherer, R; and Thompson, J.), 1955. *Marine Lab; University of Miami Spec; Restricted Rept. No* 55, 7.

Castell, C. H. and Jacqueline Dale, 1963, *Bull No. 138. Fish. Res. Bd. Can. Ottawa.*

Conway, E. J. and Byrene, A. 1933., *Biochem J.*, 27, 419-29.

deSilva, N. N., 1960, A study of the Bacteriology of North Sea Herring and the effects of certain antibiotics such as chlorotetracycline and oxytetracycline on the flora and spoilage characteristics of such herring, Ph. D thesis Aberdeen University.

de Silva, N. N. and Hughes, R. B , 1962, *J. Sci. Food Agri.* 13, 161.

Dubrova, G. B., 1961, Application of antibiotics to the preservation of food products, Moscow (Gostrogizdt).

Farber, L., 1954, *Food Tech. Campaign.*, 8, 503,

Farber, L and Lerke, P. A., 1956, *Proc. Gulf. Caribbean Fish Inst. Univer. Miami, Marine Lab. 9th Session p. 26*

Higman, J. B, Idyll, C. P and Thompson, J., 1954, *Ibid,* 6th Session, p. 114.

Joseph, K. C and Srinivasan, R., 1967, *Madras J Fish.* 3, 17-22.

Lerke, P. and Farber, L., 1957, *Antibiotics Annual* 1956-57 – p. 966. New York Medical Encyclopedia Inc.

——— and ———, 1960 a, In "Chilling of Fish", p. 24. Fish Processing Technologists Meeting Rotterdam, 1956. *The Hague. Min. Agric. Fish & Food.*

Noguchi, E. 1962, *Bull. Jap. Soc. Sci. Fish.*, 28, 100.

Novak, A. F, Fieger, E. A. and Bailey, M. E.. 1958, *Food Tech. Compaign*, 12, 585.

Shewan, J. M., 1956 a, *Fish. News. Aberd.* N. 2260, p. 10.

———, 1956 b, *Mod. Refrig.* 59, 423.

Shewan, J. M. and Stewart, J., 1958, *Bull. Int. Instt. Refring. Supplement,* p. 549.

Shewan, J. M. 1962. "The use of antibiotics in the preservation of fish" in *"Antibiotics in Agriculture"*. Editor – M. Woodbine. Proc. Univer. Nottingham. 9th Easter Scool in Agric. Sci. Publ. Butterworth, London.

Southcott, B. A. and Tarr, H. L. A.. 1961, *Canad. J. Microbiol.*, 7, 284

Southcott, B. A. and Boyd., J. W. 1965, *J. Fish. Res. Bd. Can.*, 22 (1) 117-12